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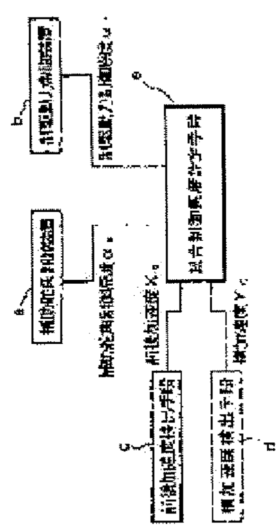
(54) INTEGRATED CONTROL DEVICE FOR AUXILIARY STEERING ANGLE AND BRAKING/DRIVING FORCE

(57)Abstract:

PURPOSE: To make the total control effect of both control devices optimum in a vehicle provided with an auxiliary steering angle control device and a braking/driving force control device simultaneously mounted thereon by discriminating vehicle state regions from each other by parameters including longitudinal acceleration, and changing control sensitivity according to the grade of control effect.



CONSTITUTION: An integrated control device is provided with an auxiliary steering angle control device (a) for controlling the steering angle of at least one of front wheels and rear wheels at the time of steering the front wheels, and a braking/driving force control device (b) for controlling at least one of the braking force and driving force of each wheel, respectively mounted on a vehicle. The integrated control device is further provided with a longitudinal acceleration detecting means (c) for detecting the longitudinal acceleration XG acting upon the vehicle. The auxiliary steering angle control sensitivity αs and the braking/driving force control sensitivity αT are then set by an integrated control sensitivity setting means (e) so as to enlarge the braking/driving force control sensitivity αr relatively to the auxiliary steering angle cotnrol sensitivity αs as the longitudinal acceleration detection value increases. The total control effect of

both control devices a, b is therefore made optimum while preventing the control quantity of the device, having a larger control effect during the simultaneous operation of both control devices a, b, from being limited.

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CLAIMS

(57) [Claim(s)]
[Claim 1] The auxiliary rudder angle control unit which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering, When the value multiplied by the amount of basic control is defined as control sensibility by the braking/driving force control unit which controls either [at least] the damping force of each ring, or driving force, the acceleration detection means before and after detecting acceleration before and after acting on a car, and the operation expression which obtains a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility is greatly set up for auxiliary rudder angle control sensibility small. The comprehensive control unit of an auxiliary rudder angle and braking/driving force characterized by having a comprehensive control sensibility setting means to make auxiliary rudder angle control sensibility small, and to set up braking/driving force control sensibility greatly as the value of an order acceleration detection value becomes large.
[Claim 2] The auxiliary rudder angle control unit which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering, The braking/driving force control unit which controls either [at least] the damping force of each ring, or driving force, When the value multiplied by the amount of basic control is defined as control sensibility by the acceleration detection means before and after detecting acceleration before and after acting on a car, lateral acceleration detection means to detect the lateral acceleration which acts on a car, and the operation expression that obtains a target controlled variable, Calculate the sum of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum of a square is below a predetermined value While setting auxiliary rudder angle control sensibility as big constant value, when braking/driving force control sensibility is set as small constant value and the operation value of the sum of a square exceeds a predetermined value Calculate the ratio of an acceleration detection value before and after receiving a lateral acceleration detection value, and when the value of the calculated ratio is small, braking/driving force control sensibility is greatly set up for auxiliary rudder angle control sensibility small. The comprehensive control unit of an auxiliary rudder angle and braking/driving force characterized by having a comprehensive control sensibility setting means to make auxiliary rudder angle control sensibility small, and to set up braking/driving force control sensibility greatly as the value of the calculated ratio becomes large.

[Translation done.]

* NOTICES *

1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
(Field of the Invention)
This invention relates to the comprehensive control unit of an auxiliary rudder angle and braking/driving force.
(Prior art)
The contents which the equipment indicated by JP,59-77968,A, for example as a rear wheel rudder angle control unit which is an example of a former and auxiliary rudder angle control unit is known, **** a rear wheel to opposition when [this] the time of the low vehicle speed or a front-wheel steering angle is conventionally large to a source, **** a rear wheel to an inphase when the time of the high vehicle speed or a front-wheel steering angle is small, and raise controllability ability are shown.
Moreover, conventionally, as a driving force allocation control unit of the four-wheel drive car which is an example of a braking/driving force control unit, the equipment indicated by JP,61-157437,A is known, for example, the driving force allocation by the side of a coupled driving wheel is increased to a source at the time of driving wheel slip generating, conventionally [this], driving force allocation is controlled to a four-flower driving direction, and the contents which raise the drive engine performance and transit stability in the time of sudden start and acceleration etc. are shown in it.
(Object of the Invention)
By however, the case where the above-mentioned rear wheel rudder angle control unit and the driving force allocation control unit of a four-wheel drive car are carried in coincidence at one car Come out, respectively and rear wheel rudder angle control sensibility and driving force proportioning-control sensibility are set up uniquely. When it considers as the configuration which carries out mutually-independent based on setting sensibility, and performs rear wheel rudder angle control and a driving force proportioning control, Although the car condition field where the control effectiveness of auxiliary rudder angle control is big originally differs from the car condition field where the control effectiveness of braking/driving force control is big, since this point is not taken into consideration at all, the thing with the optimal total control effectiveness by both control units does not become.
Moreover, by the car in which two or more control units are carried in this way, when rear wheel rudder angle control and a driving force proportioning control are performed to coincidence, while a controlled variable turns into the same controlled variable as the case where it is carried independently even if it is in the small car condition of one control effectiveness and total energy expenditure serves as size, when consumption of total energy is restricted for the reasons of fuel consumption etc., the controlled variable of a side with the large control effectiveness may be restricted.
Then, although it can consider carrying out cooperative control, or performing control with which parts for other performance degradation are compensated by one control modification, and making mutual control link in order to only raise a certain engine performance, in this case, only to the specific engine performance, effectiveness does not pass to be obtained and cannot attain optimization of the total control effectiveness.
This invention was made paying attention to the above problems, and it makes it a technical problem to attain optimization of the total control effectiveness by both control units in the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force

control unit were carried in coincidence, preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units.
(The means for solving a technical problem)
In order to solve the above-mentioned technical problem, it considered as a means to distinguish the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big with the same parameter which contains order acceleration at least, and to change control sensibility according to the size of the control effectiveness at the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force.
As shown in the Fig. corresponding to the claim of Fig. 1 , namely, in invention according to claim 1 The auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, and a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of an order acceleration detection value becomes large.
Moreover, the auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel by invention according to claim 2 at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, a lateral acceleration detection means d to detect the lateral acceleration YG which acts on a car, and a target controlled variable, Calculate the sum (XG2+YG2) of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value While setting auxiliary rudder angle control sensibility alphaS as big constant value, when braking/driving force control sensibility alphaT is set as small constant value and the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value is calculated. When the value of the calculated ratio (alphaT/alphaS) is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of the calculated ratio (alphaT/alphaS) becomes large.
 (work for)
When the value of an acceleration detection value when the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains a target controlled variable in the comprehensive control sensibility setting means e at the time of car transit if it is in invention according to claim 1, before and after detecting from the order acceleration detection means c is small, auxiliary rudder-angle control sensibility alpha S is set up greatly, and braking/driving-force control sensibility alpha T is set up small. And auxiliary rudder angle control sensibility alphaS is small set up as the value of an order acceleration detection value becomes large, and braking/driving force control sensibility alphaT is set up greatly.
Moreover, if it is in invention according to claim 2 at the time of car transit When the value multiplied by the amount of basic control is defined as control sensibility in the comprehensive control sensibility setting means e by the operation expression which obtains a target controlled variable, The sum (XG2+YG2) of the square of an order acceleration detection value and the square of a lateral acceleration detection value calculates, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value, while auxiliary rudder angle control sensibility alphaS is set

as big constant value, braking/driving force control sensibility alphaT is set as small constant value. and when the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value calculates. When the value of this calculated ratio (alphaT/alphaS) is small, auxiliary rudder angle control sensibility alphaS is set up greatly. Auxiliary rudder angle control sensibility alphaS is set up small, and braking/driving force control sensibility alphaT is greatly set up as braking/driving force control sensibility alphaT is set up small and the value of the calculated ratio (alphaT/alphaS) becomes large.

That is, although it considers as XG or (XG2+YG2) a parameter and is made to make a setting change of both control sensibility alphaS and the alphaT, this is based on the following reason.

Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call a big field the field where the control effectiveness is big.

Although auxiliary rudder angle control is effective from a linearity region to a nonlinear region in the cornering power property of a tire, since the effectiveness of other control units is large, its control effectiveness is relatively large in the linearity field of a tire property, and the control effectiveness can call it the field where little order acceleration and lateral acceleration of wheel load migration are small with a big field in a nonlinear region.

therefore -- the field distinction according to the size of the control effectiveness is possible by considering as XG or (XG2+YG2) a parameter -- becoming -- XG -- or (XG2+YG2) at the time of transit with a small value By auxiliary rudder angle control sensibility alphaS being relatively made high to braking/driving force control sensibility alphaT, change of the cornering power of a ring before and after following on braking/driving force control is suppressed small, and big auxiliary rudder angle control of the control effectiveness is fully employed efficiently. and XG -- or (XG2+YG2) at the time of transit with a large value By braking/driving force control sensibility alphaT being relatively made high to auxiliary rudder angle control sensibility alphaS Change of each ring slip ratio will be small suppressed by change of the wheel load accompanying auxiliary rudder angle control, big braking/driving force control of the control effectiveness will fully be employed efficiently, and optimization of the total control effectiveness by both the control units a and b is attained.

Moreover, even if consumption of total energy is restricted for the reasons of fuel consumption etc., in order that the energy expenditure by the side of equipment with the small control effectiveness may decrease by modification control of both control sensibility alphaS and alphaT, the controlled-variable limit by the side of the large equipment of the control effectiveness is prevented among both the control units a and b.

(The 1st example)

First, a configuration is explained.

Fig. 2 is a whole system chart showing the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit).

As for the car with which each control system was carried, engine drive is transmitted to the rear wheels 1R and 1L on either side with the torque split four-wheel drive car of the rear-drive base through an engine 2, transmission 3, a rear propeller shaft 4, the rear differential 5, and the rear drive shafts 6R and 6L on either side.

Engine drive is transmitted to the front wheels 7R and 7L on either side through a front propeller shaft 9, the front differential 10, and the front-drive shafts 11R and 11L on either side from the transfer 8 prepared in the middle of the rear propeller shaft 4.

And between the front steering-gear equipment 12 and right-and-left rear wheel 1R which steer front wheels 7R and 7L, and 1L, the front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 as a ring rudder angle control actuator before and after giving an auxiliary rudder angle to front wheels 7R and 7L and rear wheels 1R and 1L by the piston stroke by supply oil pressure are prepared.

Moreover, the oil pressure multiple disc clutch 15 as a ring driving force proportioning-control actuator

before and after giving adjustable transfer torque to a front-wheel side by bonding pressure control is built in said transfer 8.
Furthermore, between the spring top of each ring, and the bottom of a spring, oil hydraulic cylinder 16FR as an active-suspension-control actuator which suppresses rocking of a car body positively by the independent control of supply oil pressure, 16floor line, 16RR, and 16RL are prepared.
The supply oil pressure control to said front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 It is what is performed by the bulb actuation control command from the rudder angle control controller 18 to front-wheel oil-pressure-control bulb 17F and rear wheel oil-pressure-control bulb 17R. Phase inversion control which aims at the model adaptation control of a yaw rate and the coexistence of control-response nature and steering stability which a detecting signal is inputted into the rudder angle control controller 18 from the front-wheel rudder angle sensor 19 and speed sensor 20 grade, for example, obtain a desired yaw rate response at the time of revolution is performed.
The supply oil pressure control to said oil pressure multiple disc clutch 15 It is what is performed by the bulb actuation control command from the driving force allocation controller 22 to the driving force proportioning-control bulb 21. The detecting signal from the forward right ring rotation sensor 23, the forward left ring rotation sensor 24, the right rear ring rotation sensor 25, the left rear ring rotation sensor 26, and lateral acceleration sensor 27 grade is inputted into the driving force allocation controller 22. rigid [from a rear drive (0:100)] in driving force allocation -- by the ring driving force proportioning control before and after the above continuously controlled to 4WD(s) (50:50) For example, by the time of start and acceleration, control which reconciles improvement in the drive engine performance and turnability is performed by reducing driving force allocation for a front wheel at the time of revolution, and considering as a rear-drive inclination, suppressing a driving wheel slip.
The supply oil pressure control to said oil hydraulic cylinder 16FR, 16floor line, 16RR, and 16RL It is what is performed by the bulb actuation control command from the suspension control controller 29 to forward right ring control bulb 28FR, forward left ring control bulb 28floor line, right rear ring control bulb 28RR, and left rear ring control bulb 28RL. The detecting signal from the vertical acceleration sensor 30, the lateral acceleration sensor 27, the order acceleration sensor 31, and car height sensor 32 grade is inputted into the suspension control controller 29. For example, bound inhibitory control of the car-body vertical direction, inhibitory control of a car-body roll, pitching inhibitory control of a car, inhibitory control of car height change, etc. are performed.
And the detecting signal from the order acceleration sensor 31 (order acceleration detection means) and the lateral acceleration sensor 27 (lateral acceleration detection means) and the switch signal from the manual switch 33 are inputted. (XG2+YG2) and (XG/YG) are distinguished for the size field of the control effectiveness according to a car condition as a parameter. It asks for the optimal auxiliary rudder angle control sensibility alphaS for the car condition at that time, driving force proportioning-control sensibility alphaT, and wheel load proportioning-control sensibility alphaR. The comprehensive control controller 34 (comprehensive control sensibility setting means) which outputs each control sensibility alphaS, alphaT, and alphaR to said each controllers 18, 22, and 29 is formed.
In addition, said manual switch 33 is a switch into which control characteristic mode is changed in order to make an intention and liking of a driver reflect, and in the example, two, the mode A of driving force property serious consideration and the mode B of turnability serious consideration, are set up.
Although the example of an order ring rudder angle control system is shown in Fig. 3 , the example of an order ring driving force allocation system is shown in the 4th drawing 4 Fig. and the example of an active-suspension-control system is shown in a 5th [**] Fig. R> Fig., all are common knowledge and detailed explanation is omitted.
Next, the fundamental concept about a control sensibility setup by this example is explained.
(**) (XG2+YG2), reason for making (XG/YG) into the parameter which classifies the size field of the control effectiveness Although it is made to carry out a modification setup of each control sensibility alphaS, alphaT, and the alphaR first as a parameter which classifies the size field of the control effectiveness for (XG2+YG2) and (XG/YG), this is based on the following reason.
- Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call the field where the control effectiveness is big a

big acceleration field or a moderation field.

- Since a wheel load proportioning control controls the load movement magnitude between right-and-left rings (or between order rings) and controls the cornering power of a tire, its control effectiveness in the field where load migration is large is large.

That is, it becomes the field where lateral acceleration and order acceleration are big. However, greater importance is attached than to order acceleration to lateral acceleration, and this is for the direction of lateral acceleration to occur regularly in many cases.

TECHNICAL FIELD

(Field of the Invention)
This invention relates to the comprehensive control unit of an auxiliary rudder angle and braking/driving force.

[Translation done.]

PRIOR ART

(Prior art)
The contents which the equipment indicated by JP,59-77968,A, for example as a rear wheel rudder angle control unit which is an example of a former and auxiliary rudder angle control unit is known, **** a rear wheel to opposition when [this] the time of the low vehicle speed or a front-wheel steering angle is conventionally large to a source, **** a rear wheel to an inphase when the time of the high vehicle speed or a front-wheel steering angle is small, and raise controllability ability are shown. Moreover, conventionally, as a driving force allocation control unit of the four-wheel drive car which is an example of a braking/driving force control unit, the equipment indicated by JP,61-157437,A is known, for example, the driving force allocation by the side of a coupled driving wheel is increased to a source at the time of driving wheel slip generating, conventionally [this], driving force allocation is controlled to a four-flower driving direction, and the contents which raise the drive engine performance and transit stability in the time of sudden start and acceleration etc. are shown in it.

[Translation done.]

EFFECT OF THE INVENTION

(Effect of the invention)
If it is in invention according to claim 1 as explained above In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence Order acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.
In the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence if it was in invention according to claim 2 The sum of the square of order acceleration and the square of lateral acceleration is distinguished for the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big as a parameter. The effectiveness that optimization of the total control effectiveness by both control units can be attained is acquired preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units, since it considered as a means to change control sensibility according to the size of the control effectiveness.

[Translation done.]

TECHNICAL PROBLEM

(Object of the Invention)
By however, the case where the above-mentioned rear wheel rudder angle control unit and the driving force allocation control unit of a four-wheel drive car are carried in coincidence at one car Come out, respectively and rear wheel rudder angle control sensibility and driving force proportioning-control sensibility are set up uniquely. When it considers as the configuration which carries out mutually-independent based on setting sensibility, and performs rear wheel rudder angle control and a driving force proportioning control, Although the car condition field where the control effectiveness of auxiliary rudder angle control is big originally differs from the car condition field where the control effectiveness of braking/driving force control is big, since this point is not taken into consideration at all, the thing with the optimal total control effectiveness by both control units does not become. Moreover, by the car in which two or more control units are carried in this way, when rear wheel rudder angle control and a driving force proportioning control are performed to coincidence, while a controlled variable turns into the same controlled variable as the case where it is carried independently even if it is in the small car condition of one control effectiveness and total energy expenditure serves as size, when consumption of total energy is restricted for the reasons of fuel consumption etc., the controlled variable of a side with the large control effectiveness may be restricted.
Then, although it can consider carrying out cooperative control, or performing control with which parts for other performance degradation are compensated by one control modification, and making mutual control link in order to only raise a certain engine performance, in this case, only to the specific engine performance, effectiveness does not pass to be obtained and cannot attain optimization of the total control effectiveness.
This invention was made paying attention to the above problems, and it makes it a technical problem to attain optimization of the total control effectiveness by both control units in the comprehensive control unit of the car with which the auxiliary rudder angle control unit and the braking/driving force control unit were carried in coincidence, preventing that a controlled variable is restricted by the large equipment side of the control effectiveness at the time of coincidence actuation of both control units.

[Translation done.]

MEANS

(The means for solving a technical problem)
In order to solve the above-mentioned technical problem, it considered as a means to distinguish the car condition field where the control effectiveness of auxiliary rudder angle control is big, and the car condition field where the control effectiveness of braking/driving force control is big with the same parameter which contains order acceleration at least, and to change control sensibility according to the size of the control effectiveness at the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force.
As shown in the Fig. corresponding to the claim of Fig. 1 , namely, in invention according to claim 1 The auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, and a target controlled variable, When the value of an order acceleration detection value is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of an order acceleration detection value becomes large.
Moreover, the auxiliary rudder angle control unit a which controls one [at least] rudder angle of a front wheel or a rear wheel by invention according to claim 2 at the time of front-wheel steering The braking/driving force control unit b which controls either [at least] the damping force of each ring, or driving force When the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains the acceleration detection means c before and after detecting the acceleration XG before and after acting on a car, a lateral acceleration detection means d to detect the lateral acceleration YG which acts on a car, and a target controlled variable, Calculate the sum (XG2+YG2) of the square of an order acceleration detection value, and the square of a lateral acceleration detection value, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value While setting auxiliary rudder angle control sensibility alphaS as big constant value, when braking/driving force control sensibility alphaT is set as small constant value and the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value is calculated. When the value of the calculated ratio (alphaT/alphaS) is small, braking/driving force control sensibility alphaT is greatly set up for auxiliary rudder angle control sensibility alphaS small. It is characterized by having a comprehensive control sensibility setting means e to make small auxiliary rudder angle control sensibility alphaS, and to set up braking/driving force control sensibility alphaT greatly as the value of the calculated ratio (alphaT/alphaS) becomes large.
(Work for)
When the value of an acceleration detection value when the value multiplied by the amount of basic control is defined as control sensibility by the operation expression which obtains a target controlled

variable in the comprehensive control sensibility setting means e at the time of car transit if it is in invention according to claim 1, before and after detecting from the order acceleration detection means c is small, auxiliary rudder-angle control sensibility alpha S is set up greatly, and braking/driving-force control sensibility alpha T is set up small. And auxiliary rudder angle control sensibility alphaS is small set up as the value of an order acceleration detection value becomes large, and braking/driving force control sensibility alphaT is set up greatly.

Moreover, if it is in invention according to claim 2 at the time of car transit When the value multiplied by the amount of basic control is defined as control sensibility in the comprehensive control sensibility setting means e by the operation expression which obtains a target controlled variable, The sum (XG2+YG2) of the square of an order acceleration detection value and the square of a lateral acceleration detection value calculates, and when the operation value of the sum (XG2+YG2) of a square is below a predetermined value, while auxiliary rudder angle control sensibility alphaS is set as big constant value, braking/driving force control sensibility alphaT is set as small constant value. and when the operation value of the sum (XG2+YG2) of a square exceeds a predetermined value The ratio (alphaT/alphaS) of an acceleration detection value before and after receiving a lateral acceleration detection value calculates. When the value of this calculated ratio (alphaT/alphaS) is small, auxiliary rudder angle control sensibility alphaS is set up greatly. Auxiliary rudder angle control sensibility alphaS is set up small, and braking/driving force control sensibility alphaT is greatly set up as braking/driving force control sensibility alphaT is set up small and the value of the calculated ratio (alphaT/alphaS) becomes large.

That is, although it considers as XG or (XG2+YG2) a parameter and is made to make a setting change of both control sensibility alphaS and the alphaT, this is based on the following reason.

Since braking/driving force control is slip ratio control by allocation of driving force or damping force, driving force or its damping force is large, the control effectiveness is large in the field in which slip ratio serves as size, and order acceleration can call a big field the field where the control effectiveness is big.

Although auxiliary rudder angle control is effective from a linearity region to a nonlinear region in the cornering power property of a tire, since the effectiveness of other control units is large, its control effectiveness is relatively large in the linearity field of a tire property, and the control effectiveness can call it the field where little order acceleration and lateral acceleration of wheel load migration are small with a big field in a nonlinear region.

therefore -- the field distinction according to the size of the control effectiveness is possible by considering as XG or (XG2+YG2) a parameter -- becoming -- XG -- or (XG2+YG2) at the time of transit with a small value By auxiliary rudder angle control sensibility alphaS being relatively made high to braking/driving force control sensibility alphaT, change of the cornering power of a ring before and after following on braking/driving force control is suppressed small, and big auxiliary rudder angle control of the control effectiveness is fully employed efficiently. and XG -- or (XG2+YG2) at the time of transit with a large value By braking/driving force control sensibility alphaT being relatively made high to auxiliary rudder angle control sensibility alphaS Change of each ring slip ratio will be small suppressed by change of the wheel load accompanying auxiliary rudder angle control, big braking/driving force control of the control effectiveness will fully be employed efficiently, and optimization of the total control effectiveness by both the control units a and b is attained.

Moreover, even if consumption of total energy is restricted for the reasons of fuel consumption etc., in order that the energy expenditure by the side of equipment with the small control effectiveness may decrease by modification control of both control sensibility alphaS and alphaT, the controlled-variable limit by the side of the large equipment of the control effectiveness is prevented among both the control units a and b.

[Translation done.]

EXAMPLE

(The 1st example)
First, a configuration is explained.
Fig. 2 is a whole system chart showing the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit).
As for the car with which each control system was carried, engine drive is transmitted to the rear wheels 1R and 1L on either side with the torque split four-wheel drive car of the rear-drive base through an engine 2, transmission 3, a rear propeller shaft 4, the rear differential 5, and the rear drive shafts 6R and 6L on either side.
Engine drive is transmitted to the front wheels 7R and 7L on either side through a front propeller shaft 9, the front differential 10, and the front-drive shafts 11R and 11L on either side from the transfer 8 prepared in the middle of the rear propeller shaft 4.
And between the front steering-gear equipment 12 and right-and-left rear wheel 1R which steer front wheels 7R and 7L, and 1L, the front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 as a ring rudder angle control actuator before and after giving an auxiliary rudder angle to front wheels 7R and 7L and rear wheels 1R and 1L by the piston stroke by supply oil pressure are prepared.
Moreover, the oil pressure multiple disc clutch 15 as a ring driving force proportioning-control actuator before and after giving adjustable transfer torque to a front-wheel side by bonding pressure control is built in said transfer 8.
Furthermore, between the spring top of each ring, and the bottom of a spring, oil hydraulic cylinder 16FR as an active-suspension-control actuator which suppresses rocking of a car body positively by the independent control of supply oil pressure, 16floor line, 16RR, and 16RL are prepared.
The supply oil pressure control to said front-wheel oil pressure power cylinder 13 and the rear wheel oil pressure power cylinder 14 It is what is performed by the bulb actuation control command from the rudder angle control controller 18 to front-wheel oil-pressure-control bulb 17F and rear wheel oil-pressure-control bulb 17R. Phase inversion control which aims at the model adaptation control of a yaw rate and the coexistence of control-response nature and steering stability which a detecting signal is inputted into the rudder angle control controller 18 from the front-wheel rudder angle sensor 19 and speed sensor 20 grade, for example, obtain a desired yaw rate response at the time of revolution is performed.
The supply oil pressure control to said oil pressure multiple disc clutch 15 It is what is performed by the bulb actuation control command from the driving force allocation controller 22 to the driving force proportioning-control bulb 21. The detecting signal from the forward right ring rotation sensor 23, the forward left ring rotation sensor 24, the right rear ring rotation sensor 25, the left rear ring rotation sensor 26, and lateral acceleration sensor 27 grade is inputted into the driving force allocation controller 22. rigid [from a rear drive (0:100)] in driving force allocation -- by the ring driving force proportioning control before and after the above continuously controlled to 4WD(s) (50:50) For example, by the time of start and acceleration, control which reconciles improvement in the drive engine performance and turnability is performed by reducing driving force allocation for a front wheel

at the time of revolution, and considering as a rear-drive inclination, suppressing a driving wheel slip.
The supply oil pressure control to said oil hydraulic cylinder 16FR, 16floor line, 16RR, and 16RL It is what is performed by the bulb actuation control command from the suspension control controller 29 to forward right ring control bulb 28FR, forward left ring control bulb 28floor line, right rear ring control bulb 28RR, and left rear ring control bulb 28RL. The detecting signal from the vertical acceleration sensor 30, the lateral acceleration sensor 27, the order acceleration sensor 31, and car height sensor 32 grade is inputted into the suspension control controller 29. For example, bound inhibitory control of the car-body vertical direction, inhibitory control of a car-body roll, pitching inhibitory control of a car, inhibitory control of car height change, etc. are performed.
And the order acceleration sensor 31

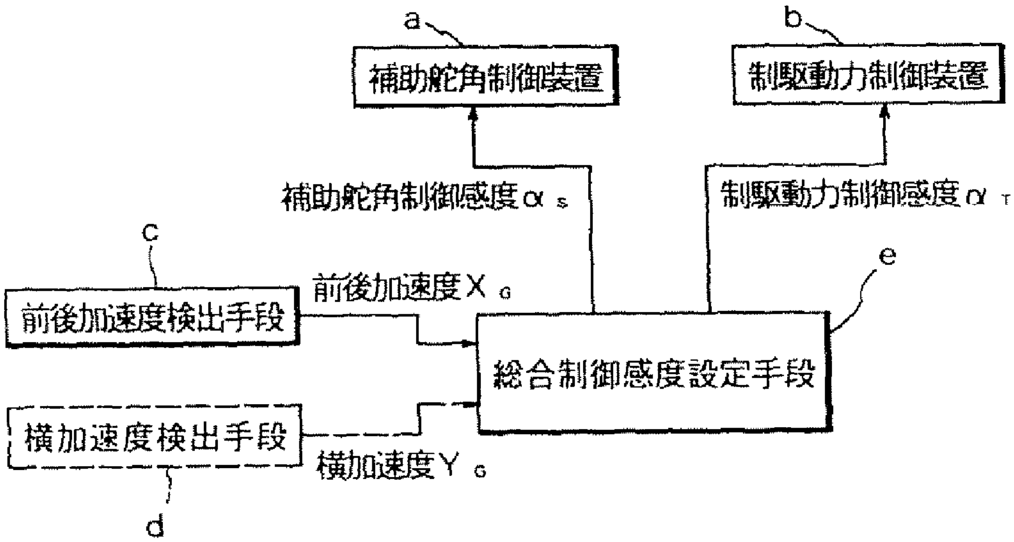
[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
The Fig. corresponding to a claim showing [1] the comprehensive control unit of the auxiliary rudder angle of this invention, and braking/driving force, The whole system chart showing [2] the coincidence loading car of an order ring rudder angle control unit (an example of an auxiliary rudder angle control unit), an order ring driving force allocation control unit (an example of a braking/driving force control unit), and active-suspension-control equipment (an example of a wheel load allocation control unit), Drawing showing [3] the example of an order ring rudder angle control unit, drawing showing [4] the example of an order ring driving force allocation control unit, Drawing showing [5] the example of active-suspension-control equipment, the field conceptual diagram showing [6] the big car condition field of the control effectiveness by each control, The flow chart with which Fig. 7 shows the flow of control sensibility setting processing actuation by the comprehensive control controller of the 1st example, It is the flow chart with which the property map Fig. [as opposed to the value of (XG2+YG2) in Fig. 8] of auxiliary rudder angle control sensibility and driving force proportioning-control sensibility and Fig. 9 show a control sensibility ratio property graphical representation, and Fig. 10 shows the flow of control sensibility setting processing actuation by the comprehensive control controller of the 2nd example.
a .... Auxiliary rudder angle control unit
b .... Braking/driving force control unit
c .... Order acceleration detection means
d .... Lateral acceleration detection means
e .... Comprehensive control sensibility setting means

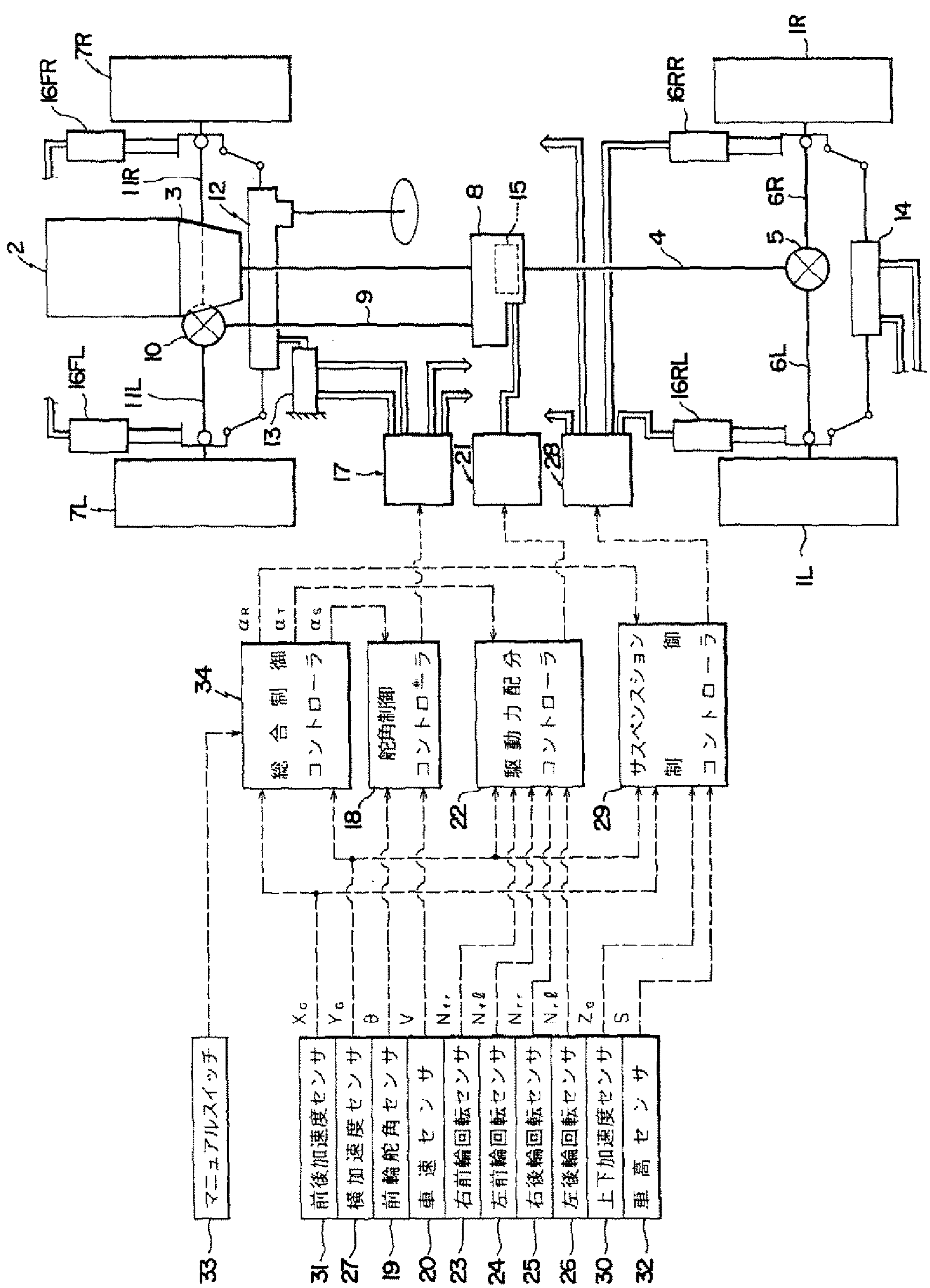
[Translation done.]

Drawing selection Drawing 1



[Translation done.]

Drawing selection Drawing 2



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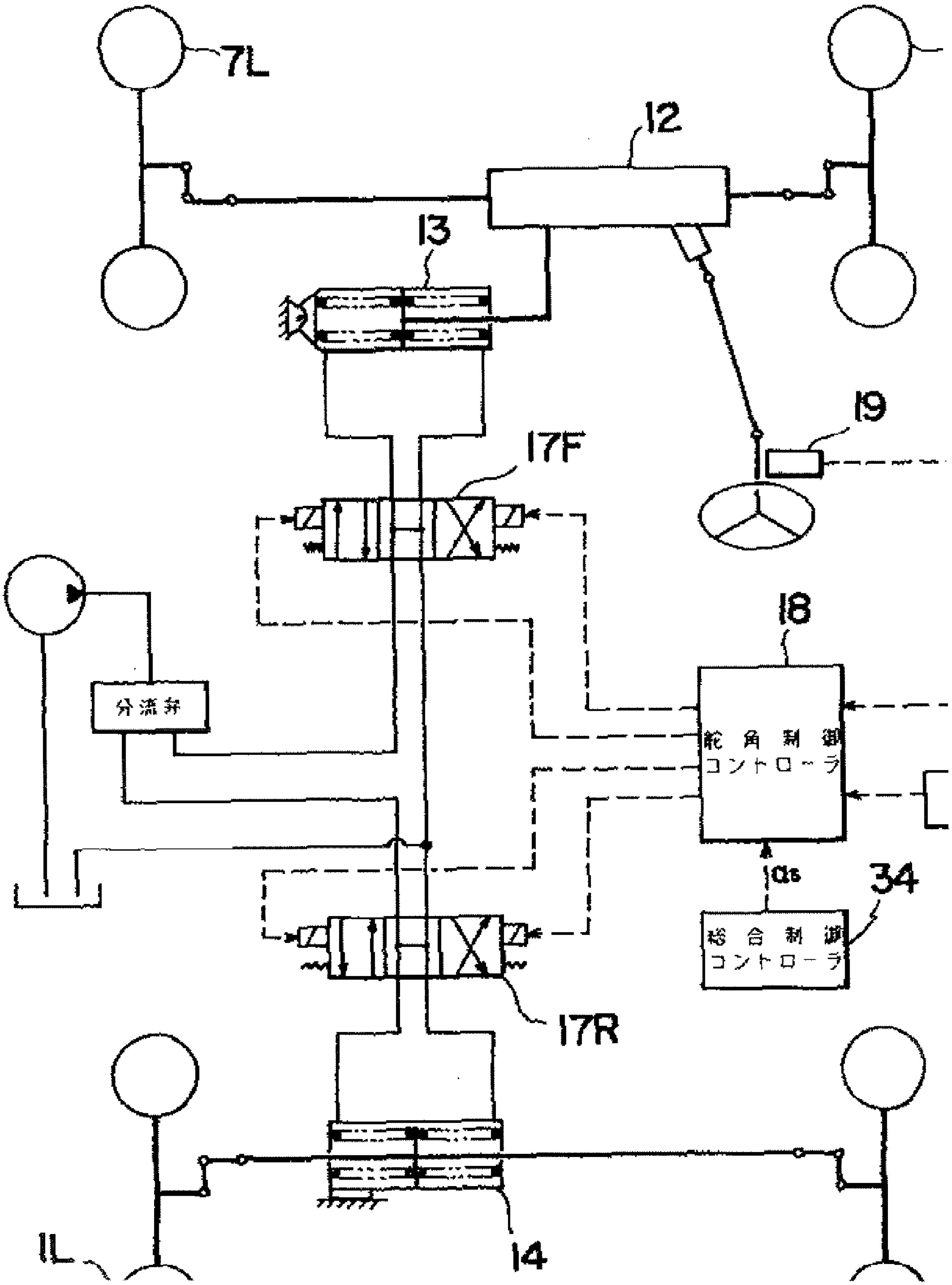
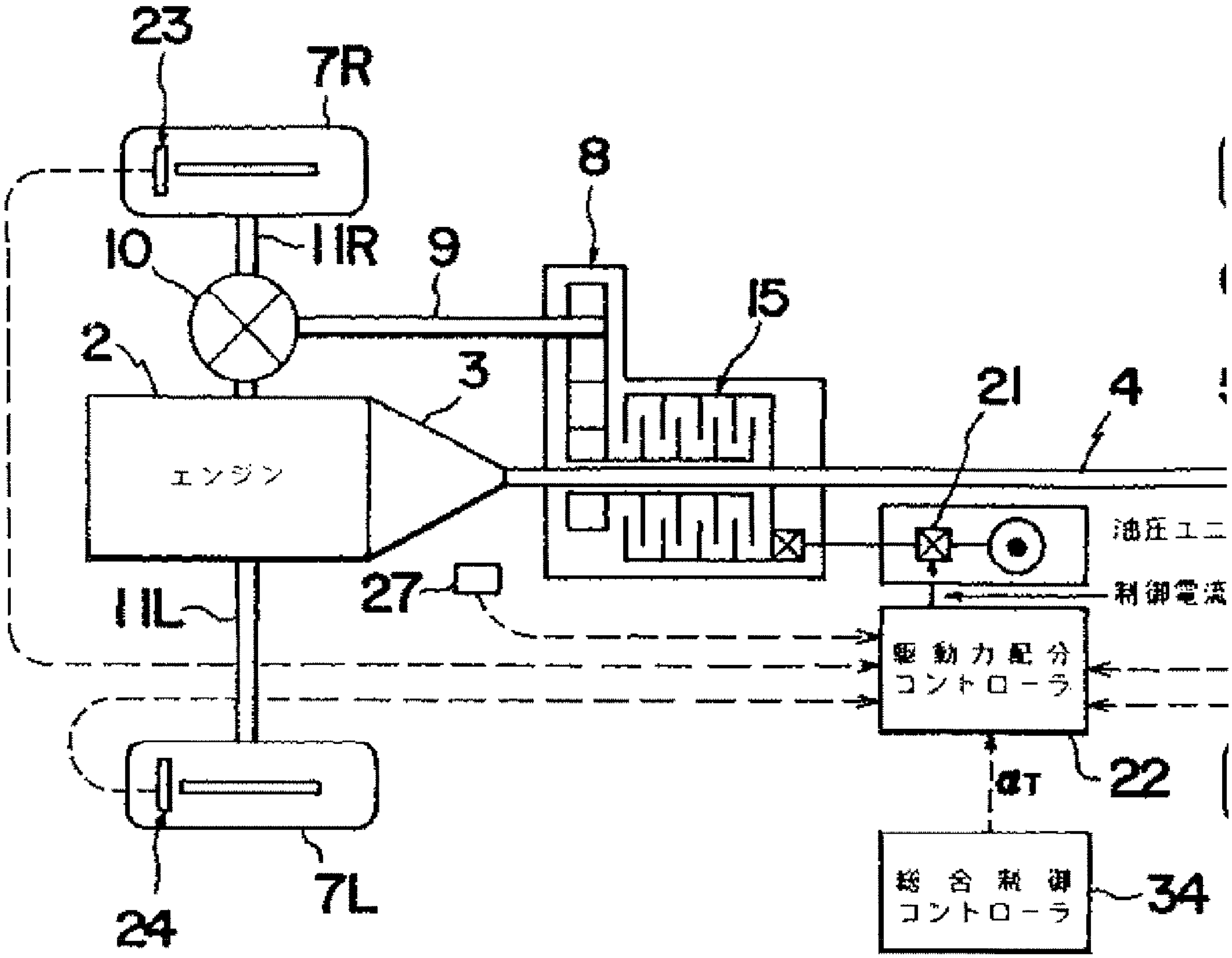
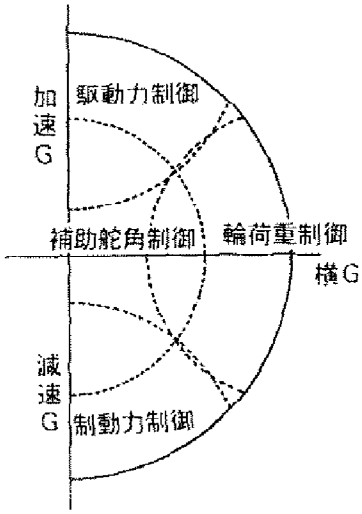

7L
12
13
19
17F
18
分流弁
舵角制御
コントローラ
αs
34
総合制御
コントローラ
17R
14
1L



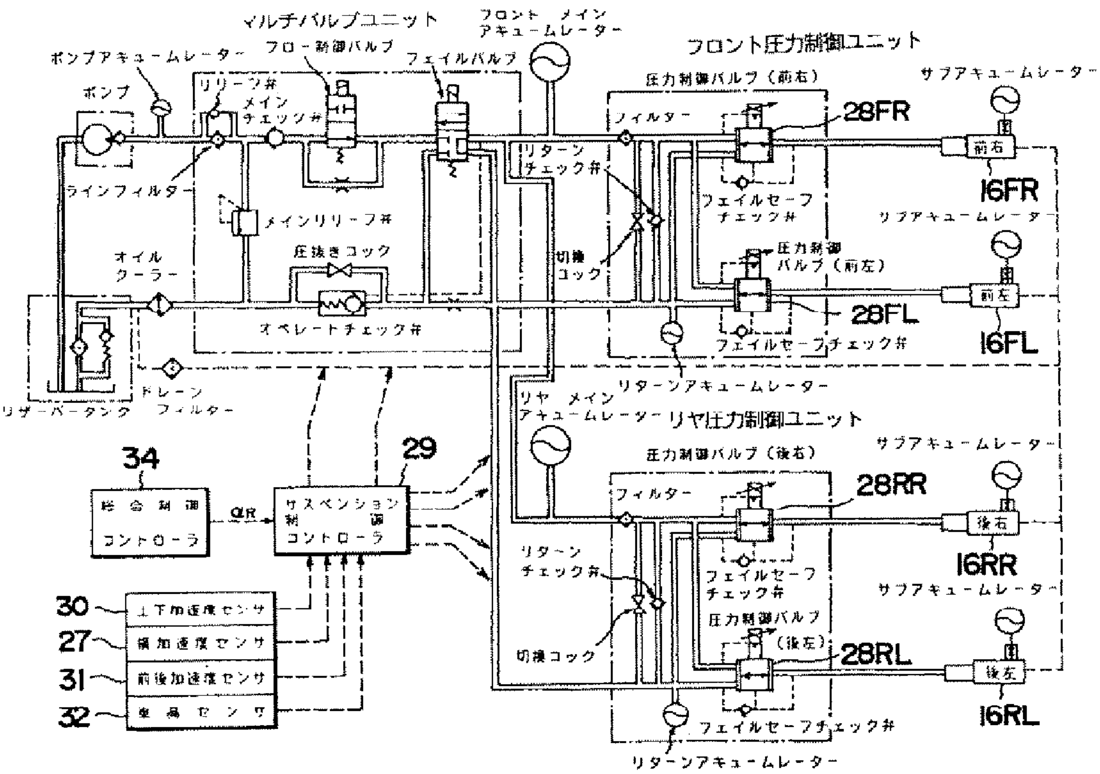
23
7R
10
11R
9
8
15
2
3
21
4
エンジン
油圧ユニ
27
制御電流
11L
駆動力配分
コントローラ
22
α_T
7L
24
総合制御
コントローラ
34

Drawing selection Drawing 6



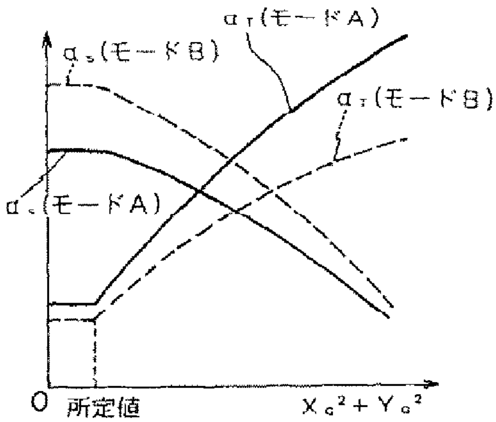
[Translation done.]

Drawing selection Drawing 5



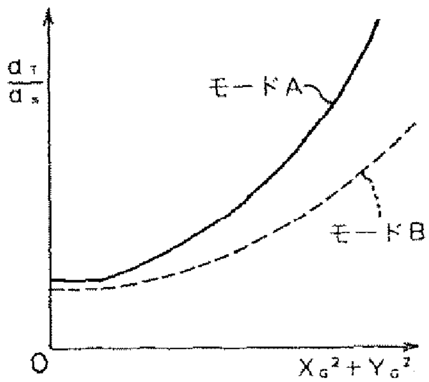
[Translation done.]

Drawing selection Drawing 8



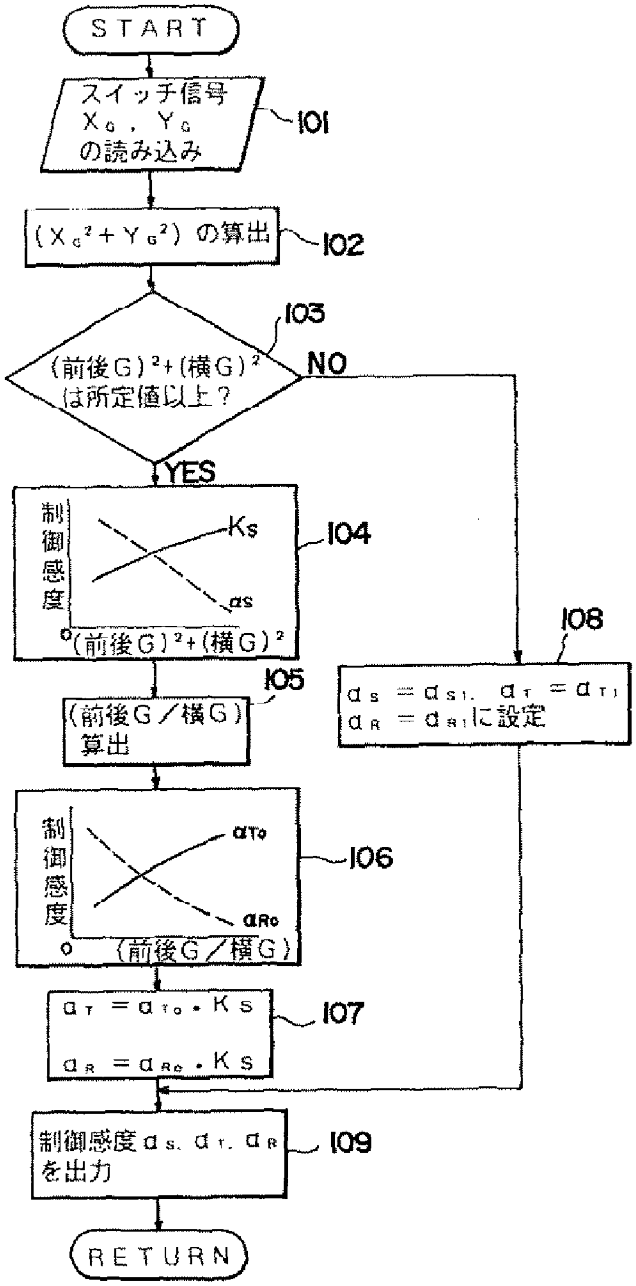
[Translation done.]

Drawing selection Drawing 9



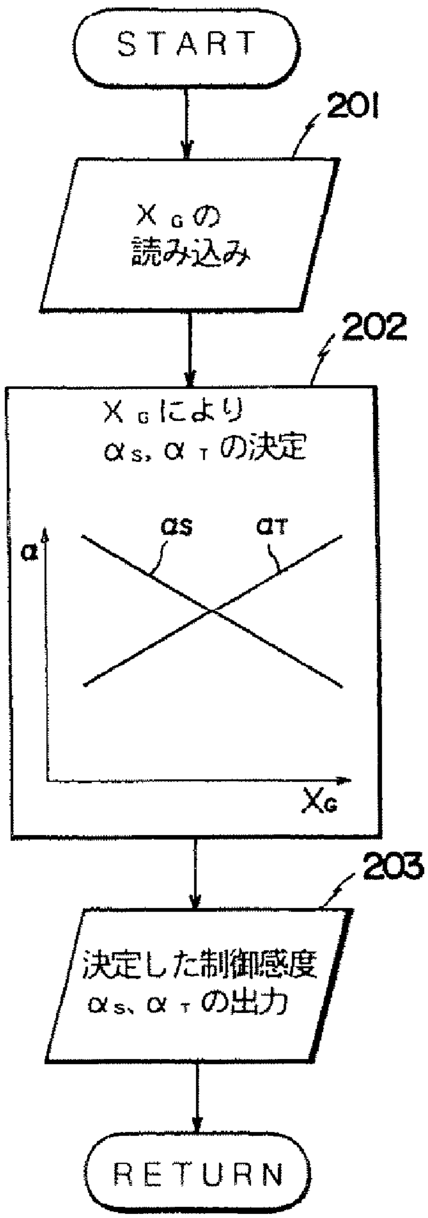
[Translation done.]

Drawing selection Drawing 7



[Translation done.]

Drawing selection Drawing 10



[Translation done.]

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B 62 D 101:00		
103:00		
113:00		

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審査請求　未請求　請求項の数 2　（全11頁）

⑤発明の名称　補助舵角と制駆動力の総合制御装置

㉑特　願　平2－104044
㉒出　願　平2(1990)4月18日

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明　細　書

1. 発明の名称

補助舵角と制駆動力の総合制御装置

2. 特許請求の範囲

1) 前輪または後輪の少なくとも一方の舵角を前輪操舵時に制御する補助舵角制御装置と、

各輪の制動力または駆動力の少なくとも一方を制御する制駆動力制御装置と、

車両に作用する前後加速度を検出する前後加速度検出手段と、

前後加速度検出値の値が大きいほど補助舵角制御感度に対して制駆動力制御感度を相対的に大きくするように補助舵角制御感度と制駆動力制御感度を設定する総合制御感度設定手段と、

を備えている事を特徴とする補助舵角と制駆動力の総合制御装置。

2) 前輪または後輪の少なくとも一方の舵角を前輪操舵時に制御する補助舵角制御装置と、

各輪の制動力または駆動力の少なくとも一方の配分を制御する制駆動力制御装置と、

車両に作用する前後加速度を検出する前後加速度検出手段と、

車両に作用する横加速度を検出する横加速度検出手段と、

前後加速度検出値の二乗と横加速度検出値の二乗の和を演算し、この和の値が大きいほど補助舵角制御感度に対する制駆動力制御感度の比の値が大きくなるように補助舵角制御感度と制駆動力制御感度を設定する総合制御感度設定手段と、

を備えている事を特徴とする補助舵角と制駆動力の総合制御装置。

3.発明の詳細な説明

(産業上の利用分野)

本発明は、補助舵角と制駆動力の総合制御装置に関する。

(従来の技術)

従来、補助舵角制御装置の一例である後輪舵角制御装置としては、例えば、特開昭59-77968号公報に記載されている装置が知られていて、この従来出典には、低車速時或は前輪操舵角が大きい時等には後輪を逆相に転舵し、高車速時或は前輪操舵角が小さい時等には後輪を同相に転舵し、操縦性能を高める内容が示されている。

また、従来、制駆動力制御装置の一例である四輪駆動車の駆動力配分制御装置としては、例えば、特開昭61-157437号公報に記載されている装置が知られて、この従来出典には、駆動輪スリップ発生時に従動輪側への駆動力配分を増して4輪駆動方向に駆動力配分を制御し、急発進時や加速時等において駆動性能と走行安定性を高める内容が示されている。

(発明が解決しようとする課題)

しかしながら、上記後輪舵角制御装置と四輪駆動車の駆動力配分制御装置とを同時に1つの車両に搭載した場合で、後輪舵角制御感度と駆動力配分制御感度をそれぞれで独自に設定し、設定感度に基づき互いに独立して後輪舵角制御と駆動力配分制御を行なう構成とした場合、本来、補助舵角制御の制御効果が大きな車両状態領域と制駆動力制御の制御効果が大きな車両状態領域とが異なっているにもかかわらずこの点が全く考慮されない為、両制御装置によるトータル的な制御効果が最適なものとはならない。

また、後輪舵角制御と駆動力配分制御とが同時に行なわれる場合、一方の制御効果の小さな車両状態であっても制御量は単独で搭載される場合と同じ制御量となりトータルのエネルギ消費が大となると共に、このように複数の制御装置が搭載される車両では燃費等の理由によりトータルのエネルギの消費が限られる場合には、制御効果の大きい側の制御量が制限されることがある。

そこで、単にある性能を向上させるために協調制御したり、一方の制御変更により他の性能劣化分を補う制御を行ない、互いの制御をリンクさせることが考えられるが、この場合、特定の性能に対してのみ効果が得られるに過ぎず、トータル的な制御効果の最適化を達成し得ない。

本発明は、上述のような問題に着目してなされたもので、補助舵角制御装置と制駆動力制御装置とが同時に搭載された車両の総合制御装置において、両制御装置の同時作動時に制御効果の大きい装置側で制御量が制限されるのを防止しながら、両制御装置によるトータル的な制御効果の最適化を図ることを課題とする。

(課題を解決するための手段)

上記課題を解決するために本発明の補助舵角と制駆動力の総合制御装置では、補助舵角制御の制御効果が大きな車両状態領域と制駆動力制御の制御効果が大きな車両状態領域とを少なくとも前後加速度を含む同じパラメータにより区別し、制御効果の大小に応じて制御感度を変更する手段とした。

即ち、第1図のクレーム対応図に示すように、請求項1記載の発明では、前輪または後輪の少なくとも一方の舵角を前輪操舵時に制御する補助舵角制御装置aと、各輪の制動力または駆動力の少なくとも一方を制御する制駆動力制御装置bと、車両に作用する前後加速度X_Gを検出する前後加速度検出手段cと、前後加速度検出値の値が大きいほど補助舵角制御感度α_sに対して制駆動力制御感度α_Tを相対的に大きくするように補助舵角制御感度α_sと制駆動力制御感度α_Tを設定する総合制御感度設定手段eと、を備えている事を特徴とする。

また、請求項2記載の発明では、前輪または後輪の少なくとも一方の舵角を前輪操舵時に制御する補助舵角制御装置aと、各輪の制動力または駆動力の少なくとも一方を制御する制駆動力制御装置bと、車両に作用する前後加速度X_Gを検出する前後加速度検出手段cと、車両に作用する横加速度Y_Gを検出する横加速度検出手段dと、前後加速度

検出値の二乗と横加速度検出値の二乗の和($X_G{}^2+Y_G{}^2$)を演算し、この和($X_G{}^2+Y_G{}^2$)の値が大きいほど補助舵角制御感度α_Sに対する制駆動力制御感度α_Tの比(α_T/α_S)の値が大きくなるように補助舵角制御感度α_Sと制駆動力制御感度α_Tを設定する総合制御感度設定手段eと、を備えている事を特徴とする。

(作　用)

車両走行時に、請求項1記載の発明にあっては、総合制御感度設定手段eにおいて、前後加速度検出手段cから検出される前後加速度検出値の値が大きいほど補助舵角制御感度α_Sに対して制駆動力制御感度α_Tを相対的に大きくするように補助舵角制御感度α_Sと制駆動力制御感度α_Tが設定される。

また、車両走行時に、請求項2記載の発明にあっては、総合制御感度設定手段eにおいて、前後加速度検出手段cから検出される前後加速度検出値の二乗と横加速度検出手段dから検出される横加速度検出値の二乗の和($X_G{}^2+Y_G{}^2$)が演算され、この和($X_G{}^2+Y_G{}^2$)の値が大きいほど補助舵角制御感度α_Sに対する制駆動力制御感度α_Tの比(α_T/α_S)の値が大きくなるように補助舵角制御感度α_Sと制駆動力制御感度α_Tとが設定される。

つまり、X_Gもしくは($X_G{}^2+Y_G{}^2$)をパラメータとして両制御感度α_S, α_Tを設定変更するようにしているが、これは下記の理由による。

制駆動力制御は、駆動力又は制動力の配分によるスリップ率コントロールであるので駆動力又は制動力が大きく、スリップ率が大となる領域で制御効果が大きく、制御効果が大きな領域とは前後加速度が大きな領域ということができる。

補助舵角制御は、タイヤのコーナリングパワー特性において線形域から非線形域まで効果があるが、非線形域では他の制御装置の効果が大きい為、相対的にタイヤ特性の線形領域で制御効果が大きく、制御効果が大きな領域とは輪荷重移動の少ない前後加速度及び横加速度が小さな領域ということができる。

従って、X_Gもしくは($X_G{}^2+Y_G{}^2$)をパラメータとすることで制御効果の大小に応じた領域区別が可能となり、X_Gもしくは($X_G{}^2+Y_G{}^2$)の値が小さい走行時には、補助舵角制御感度α_Sが制駆動力制御感度α_Tに対して相対的に高めとされることで、制駆動力制御に伴なう前後輪のコーナリングパワーの変化が小さく抑えられ、制御効果の大きな補助舵角制御が十分に生かされるし、X_Gもしくは($X_G{}^2+Y_G{}^2$)の値が大きい走行時には、制駆動力制御感度α_Tが補助舵角制御感度α_Sに対して相対的に高めとされることで、補助舵角制御に伴なう輪荷重の変化で各輪スリップ率の変化が小さく抑えられ、制御効果の大きな制駆動力制御が十分に生かされることになり、両制御装置a，bによるトータル的な制御効果の最適化が図られる。

また、燃費等の理由によりトータルのエネルギの消費が限られても両制御感度α_S, α_Tの変更制御により制御効果が小さい装置側でのエネルギ消費が減少する為、両制御装置a，bのうち制御効果の大きい装置側での制御量制限が防止される。

(第1実施例)

まず、構成を説明する。

第2図は前後輪舵角制御装置(補助舵角制御装置の一例)と前後輪駆動力配分制御装置(制駆動力制御装置の一例)とアクティブサスペンション制御装置(輪荷重配分制御装置の一例)との同時搭載車両を示す全体システム図である。

各制御システムが搭載された車両は、後輪駆動ベースのトルクスプリット四輪駆動車で、左右の後輪1R, 1Lには、エンジン2、トランスミッション3，リアプロペラシャフト4、リアディファレンシャル5，左右のリアドライブシャフト6R, 6Lを介してエンジン駆動力が伝達される。

左右の前輪7R, 7Lには、リアプロペラシャフト4の途中に設けられたトランスファ8からフロントプロペラシャフト9，フロントディファレンシャル10，左右のフロントドライブシャフト11R，11Lを介してエンジン駆動力が伝達される。

そして、前輪7R, 7Lを操舵するフロントステアリングギア装置12及び左右後輪1R, 1L間には、

供給油圧によるピストンストロークで前輪7R, 7L及び後輪1R, 1Lに補助舵角を与える前後輪舵角制御アクチュエータとしての前輪油圧パワーシリンダ13及び後輪油圧パワーシリンダ14が設けられる。

また、前記トランスファ8には、締結圧制御により前輪側へ可変の伝達トルクを与える前後輪駆動力配分制御アクチュエータとしての油圧多板クラッチ15が内蔵される。

さらに、各輪のばね上とばね下間には、供給油圧の独立制御により車体の揺動を積極的に抑えるアクティブサスペンション制御アクチュエータとしての油圧シリンダ16FR, 16FL, 16RR, 16RLが設けられている。

前記前輪油圧パワーシリンダ13及び後輪油圧パワーシリンダ14への供給油圧制御は、前輪油圧制御バルブ17F及び後輪油圧制御バルブ17Rに対する舵角制御コントローラ18からのバルブ作動制御指令により行なわれるもので、舵角制御コントローラ18には前輪舵角センサ19、車速センサ20等から検出信号が入力され、例えば、旋回時に所望のヨーレート応答を得るヨーレイトのモデル適合制御や操舵応答性と操舵安定性の両立を目指す位相反転制御等が行なわれる。

前記油圧多板クラッチ15への供給油圧制御は、駆動力配分制御バルブ21に対する駆動力配分コントローラ22からのバルブ作動制御指令により行なわれるもので、駆動力配分コントローラ22には右前輪回転センサ23、左前輪回転センサ24、右後輪回転センサ25、左後輪回転センサ26、横加速度センサ27等からの検出信号が入力され、駆動力配分を後輪駆動(0:100)からリジッド4WD(50:50)まで連続的に制御する上記前後輪駆動力配分制御により、例えば、発進時や加速時等では駆動輪スリップを抑えながら、旋回時には前輪への駆動力配分を減じて後輪駆動傾向とすることで、駆動性能と旋回性能の向上を両立させる制御等が行なわれる。

前記油圧シリンダ16FR, 16FL, 16RR, 16RLへの供給油圧制御は、右前輪制御バルブ28FR、左前輪制御バルブ28FL、右後輪制御バルブ28RR、左後輪制御バルブ28RLに対するサスペンション制御コントローラ29からのバルブ作動制御指令により行なわれるもので、サスペンション制御コントローラ29には上下加速度センサ30、横加速度センサ27、前後加速度センサ31、車高センサ32等からの検出信号が入力され、例えば、車体上下方向のバウンド抑制制御や車体ロールの抑制制御や車両のピッチング抑制制御や車高変化の抑制制御等が行なわれる。

そして、前後加速度センサ31(前後加速度検出手段)及び横加速度センサ27(横加速度検出手段)からの検出信号とマニュアルスイッチ33からのスイッチ信号を入力し、車両状態に応じた制御効果の大小領域を$(X_G{}^2+Y_G{}^2)$と(X_G/Y_G)をパラメータとして区別し、その時の車両状態に最適である補助舵角制御感度α_sと駆動力配分制御感度α_Tと輪荷重配分制御感度α_Rを求め、各制御感度$\alpha_S, \alpha_T, \alpha_R$を前記各コントローラ18, 22, 29に出力する総合制御コントローラ34(総合制御感度設定手段)が設けられている。

尚、前記マニュアルスイッチ33は、ドライバーの意図や好みを反映させるために制御特性モードを変更するスイッチで、実施例では駆動力特性重視のモードAと旋回性重視のモードBの2つが設定されている。

第3図に前後輪舵角制御システムの具体例を示し、第4図に前後輪駆動力配分システムの具体例を示し、第5図にアクティブサスペンション制御システムの具体例を示すが、いずれも周知であり詳しい説明は省略する。

次に、本実施例での制御感度設定に関する基本概念を説明する。

(イ) $(X_G{}^2+Y_G{}^2)$, (X_G/Y_G)を制御効果の大小領域を区分するパラメータとする理由

まず、$(X_G{}^2+Y_G{}^2)$, (X_G/Y_G)を制御効果の大小領域を区分するパラメータとして各制御感度α_S, α_T, α_Rを変更設定するようにしているが、これは下記の理由による。

・制駆動力制御は、駆動力又は制動力の配分によ

るスリップ率コントロールであるので駆動力又は制動力が大きく、スリップ率が大となる領域で制御効果が大きく、制御効果が大きな領域とは前後加速度が大きな加速領域又は減速領域ということができる。

・輪荷重配分制御は、左右輪間の荷重移動量（又は前後輪間）をコントロールしてタイヤのコーナリングパワーをコントロールするので、荷重移動が大きい領域での制御効果が大きい。

つまり、横加速度や前後加速度の大きな領域となる。但し、前後加速度より横加速度を重視するもので、これは、横加速度の方が定常的に発生することが多いためである。

・補助舵角制御は、タイヤのコーナリングパワー特性において線形域から非線形域まで効果があるが、非線形域では他の制御装置の効果が大きい為、相対的にタイヤ特性の線形領域で制御効果が大きく、制御効果が大きな領域とは輪荷重移動の少ない前後加速度及び横加速度が小さな領域ということができる。

従って、各制御感度 $\alpha_S, \alpha_T, \alpha_H$ により制御効果の大きな車両状態領域を概念図により示すと第6図のようになる。

（ロ）制御感度を固定値とした場合の問題

a)　補助舵角制御が得意な $(X_G^2+Y_G^2)$ が小さい領域での問題

・制駆動力制御について

基本的にこの領域では制御が不必要であり、パワーが無駄となるし、補助舵角制御にたくさんパワー（例えば、油圧制御の際の油圧）をかけて補助舵角制御効果を大きくしたいにもかかわらず、燃費等の理由によりトータルの出力が限られるため、補助舵角制御装置で必要なパワーを得られない。

性能的には、制駆動力が変化するのに連動して前後輪のコーナリングパワーが変化し、コーナリングパワーの変化が無いものとして制御している補助舵角制御装置の制御効果が損なわれる。

・輪荷重配分制御について

パワーが無駄になることと補助舵角制御装置のパワーが得られなくなる点は、制駆動力制御と同様である。

性能的には、補助舵角制御の単独制御はステア特性がある一定値と考えて制御を行なっているが、輪荷重配分制御によりステア特性が変化してしまい（具体的には前後のコーナリングパワーのバランスが変化する）、補助舵角制御が本来狙っていた特性が得られなくなる。

b)　輪荷重配分制御が得意な $(X_G^2+Y_G^2)$ が大で、(X_G/Y_G) が小の領域での問題

・補助舵角制御について

パワーが無駄になることと輪荷重配分制御装置のパワーが得られなくなる点は、他と同様である。

性能的には、例えば、補助舵角制御を行なった為にタイヤの横滑り角が変化してしまいタイヤに働く横力，前後力の向きが変化し、輪荷重の移動量が変化する（後輪を逆相に切ると横滑り角が旋回内側を向くように発生し、前内輪の輪荷重が減少し、後外輪の輪荷重が増大する）。

従って、輪荷重配分制御の制御前の状態が、補助舵角制御の有無により違っていて、輪荷重配分制御で狙った通りの制御が適切に行なえない。

・制駆動力制御について

パワーが無駄になることと輪荷重配分制御装置のパワーが得られなくなる点は、他と同様である。

性能的には、例えば、前後輪駆動力配分制御では駆動力配分を変化させるために前後輪のスリップ率が変動する。輪荷重配分制御でステア特性の制御を行なって各輪の発生するコーナリングフォースを最適にしたいにもかかわらず、スリップ率の変動によりコーナリングフォースが最適値よりずれてしまう。

c)　制駆動力制御が得意な $(X_G^2+Y_G^2)$ が大で、(X_G/Y_G) が大の領域での問題

・補助舵角制御について

パワーが無駄になることと制駆動力制御装置のパワーが得られなくなる点は、他と同様である。

性能的には、例えば、補助舵角制御を行なった為

にタイヤの横滑り角が変化してしまいタイヤに働く横力，前後力の向きが変化し、輪荷重の移動量が変化する（後輪を逆相に切ると横滑り角が旋回内側を向くように発生し、前内輪の輪荷重が減少して前内輪が空転する）。

従って、輪荷重の変化によって各輪のスリップ率が変化し、最終的には前後輪回転速度差が補助舵角制御の有無により異なってくるために狙った通りの制御が行なえない。

・輪荷重配分制御について

パワーが無駄になることと輪荷重配分制御装置のパワーが得られなくなる点は、他と同様である。

性能的には、例えば、輪荷重配分制御を行なった為にある一輪の輪荷重が減少するとそのタイヤのスリップ率は増大し、最悪の場合、空転してしまい前後輪の回転速度差が輪荷重配分制御の有無により変ってしまう為、狙い通りの制御が行なえない。

次に、作用を説明する。

第7図は各制御感度$\alpha_S, \alpha_T, \alpha_R$を設定して各コントローラ18，22，29に出力する総合制御コントローラ34での制御感度設定処理作動の流れを示すフローチャートで、以下、各ステップについて説明する。

ステップ101では、マニュアルスイッチ33からのスイッチ信号と前後加速度センサ31及び横加速度センサ27からのセンサ信号が読み込まれる。

ステップ102では、前後加速度X_Gの二乗と横加速度Y_Gの二乗の和が算出される。

ステップ103では、$(X_G^2+Y_G^2)$の値が所定値以上かどうかが判断される。

この判断で、$(X_G^2+Y_G^2)$の値が所定値未満であれば、ステップ108へ進み、補助舵角制御感度α_S，駆動力配分制御感度α_T，輪荷重配分制御感度α_Rをそれぞれα_{S1}，α_{T1}，α_{R1}に設定する。

ここで、α_{T1}，α_{R1}はα_{S1}に対してきわめて小さな値に設定し、補助舵角制御効果が大きくなるようにする。例えば、$\alpha_{S1}=1$でα_{T1}，$\alpha_{R1}\fallingdotseq 0$としても良い。

一方、ステップ103の判断で、$(X_G^2+Y_G^2)$の値が所定値以上と判断された場合には，ステップ104以降に進む。

ステップ104では、ステップ枠内に記載されている$(X_G^2+Y_G^2)$の値に対する補助舵角制御感度特性マップ及び制御ゲイン特性マップにより補助舵角制御感度α_Sと制御ゲインK_Sの値が算出される。

尚、これらの特性マップはマニュアルスイッチ33による特性モードにより選択されるが、基本的に、補助舵角制御感度α_Sは、$(X_G^2+Y_G^2)$の値が大きくなるほど小さくなり（右下がり）、制御ゲインK_Sは、$(X_G^2+Y_G^2)$の値が大きくなるほど大きくなる（右上がり）特性に設定している。

ステップ105では、(X_G/Y_G)の値が算出される。

ステップ106では、ステップ枠内に記載されている(X_G/Y_G)の値に対する駆動力配分制御感度特性マップ及び輪荷重配分制御感度特性マップにより駆動力配分基本制御感度α_{T0}と輪荷重配分基本制御感度α_{R0}の値が算出される。

尚、これらの特性マップはマニュアルスイッチ33による特性モードにより選択されるが、基本的に、駆動力配分基本制御感度α_{T0}は、(X_G/Y_G)の値が大きくなるほど大きくなり（右上がり），輪荷重配分基本制御感度α_{R0}は、(X_G/Y_G)の値が大きくなるほど小さくなる（右下がり）特性に設定している。

ステップ107では、前記ステップ106で求められた基本制御感度α_{T0}，α_{R0}を下記の式で補正を行ない、駆動力配分制御感度α_T及び輪荷重配分制御感度α_Rが算出される。

$\alpha_T = \alpha_{T0} \cdot K_S$

$\alpha_R = \alpha_{R0} \cdot K_S$

ステップ109では、ステップ104及びステップ107もしくはステップ108で得られた各制御感度$\alpha_S, \alpha_T, \alpha_R$が、それぞれ舵角制御コントローラ18，駆動力配分コントローラ22，サ

スペンション制御コントローラ２９へ出力される。

以上の各制御感度α_S, α_T, α_Rの設定に基づいて各コントローラ１８，２２，２９では下記のような制御が行なわれる。

舵角制御コントローラ１８では、下記の式に示すように、基本制御舵角f_{sf}及びf_{sr}に補助舵角制御感度α_Sを掛け合わせた値が前輪補助舵角目標値δ_F^*及び後輪補助舵角目標値δ_R^*とされ、この目標値δ_F^*, δ_R^*が得られる指令信号が前輪舵角制御バルブ17F 及び後輪舵角制御バルブ17R に出力される。

$\delta_F^* = \alpha_S \cdot f_{sf}$ (θ, V)

$\delta_R^* = \alpha_S \cdot f_{sr}$ (θ, V)

駆動力配分コントローラ２２では、下記の式に示すように、基本前輪側駆動力配分割合f_Tに駆動力配分制御感度α_Tを掛け合わせた値が駆動力配分前輪割合目標値T_F^*とされ、この目標値T_F^*が得られる指令信号が駆動力配分制御バルブ２１に出力される。

$T_F^* = \alpha_T \cdot f_T$ (ΔN, Y_G)

但し、ΔNは前後輪回転速度差であって、各回転センサ２３，２４，２５，２６からの信号により後輪回転速度Nrと前輪回転速度Nfを求め、これらの差をとる次式により得られる。

ΔN = Nr − Nf

サスペンション制御コントローラ２９では、下記の式に示すように、基本輪荷重配分割合f_Rに輪荷重配分制御感度α_Rを掛け合わせた値が輪荷重配分割合目標値R_S^*とされる。

$R_S^* = \alpha_R \cdot f_R(Z_G, X_G, Y_G, S)$

以上説明したように、本発明である補助舵角と制駆動力の総合制御装置の実施例に相当する前後輪舵角制御と前後輪駆動力配分制御をみた場合、下記に列挙する効果が発揮される。

① $(X_G^2 + Y_G^2)$をパラメータとすることで制御効果の大小に応じた領域区別が可能となり、第８図の特性マップに示すように、$(X_G^2 + Y_G^2)$の値が小さい走行時には、補助舵角制御感度α_Sが駆動力配分制御感度α_Tに対して相対的に高めとされることで、駆動力配分制御に伴なう前後輪のコーナリングパワーの変化が小さく抑えられ、制御効果の大きな前後輪舵角制御が十分に生かされる。
また、$(X_G^2 + Y_G^2)$の値が大きい走行時には、駆動力配分制御感度α_Tが補助舵角制御感度α_Sに対して相対的に高めとされることで、前後輪舵角制御に伴なう輪荷重配分の変化で各輪スリップ率の変化が小さく抑えられ、制御効果の大きな駆動力配分制御が十分に生かされることになる。
即ち、補助舵角と駆動力配分の両制御装置によるトータル的な制御効果の最適化が図られる。

② 燃費等の理由によりトータルのエネルギの消費が限られても両制御感度α_S, α_Tの変更制御により制御効果が小さい装置側でのエネルギ消費が減少する為、補助舵角と駆動力配分の両制御装置のうち制御効果の大きい装置側での制御量制限が防止される。

③ マニュアルスイッチ３３を設け、第８図及び第９図に示すように、駆動力特性重視モードAと旋回性重視モードBのいずれかを選択が可能とした為、ドライバーの好みや走行路面等に対応して搭載装置の性能を引き出すことができる。

（第２実施例）

次に、請求項１記載の発明に相当する第２実施例の補助舵角と制駆動力の総合制御装置について説明する。

第１実施例は、輪荷重配分制御装置を含むシステムである為、前後加速度X_Gと横加速度Y_Gの両者により制御感度の大小を決定する例を示したが、この第２実施例は補助舵角制御装置と制駆動力制御装置との２つの装置が同時に搭載された車両であって、請求項１に記載したように、横加速度Y_Gを検出することなく、前後加速度X_Gのみを検出して補助舵角制御感度α_Sと駆動力配分制御感度α_Tとを設定するようにした例である。

構成的には、第１実施例装置において、サスペンション制御系が省略されたシステムとなり、他の構成は変更ないので、説明を省略する。

次に、第１０図は第２実施例の総合制御コントローラ３４で行なわれる制御感度設定処理作動の

流れを示すフローチャートで、以下、各ステップについて説明する。

ステップ201では、前後加速度センサ31から前後加速度X_Gが読み込まれる。

ステップ202では、前後加速度X_Gに基づいてステ枠内に記載されている制御感度特性マップに従って補助舵角制御感度α_Sと駆動力配分制御感度α_Tが決定される。

即ち、低前後加速度域では駆動力配分制御感度α_Tより補助舵角制御感度α_Sが高めの値とされ、高前後加速度域では補助舵角制御感度α_Sより駆動力配分制御感度α_Tが高めの値とされる。

ステップ203では、ステップ202で決定された両制御感度α_S, α_Tが舵角制御コントローラ18と駆動力配分コントローラ22に出力される。

従って、第1実施例と同様に、両制御装置の同時作動時に制御効果の大きい装置側で制御量が制限されるのを防止しながら、両制御装置によるトータル的な制御効果の最適化を図ることが出来る。

以上、実施例を図面に基づいて説明してきたが、具体的な構成はこの実施例に限られるものではなく、本発明の要旨を逸脱しない範囲における設計変更等があっても本発明に含まれる。

例えば、実施例では制御感度α_S, α_Tが交差する特性（第8図）の例を示したが、必ずしも両特性が交差する必要はなく、第9図に示すように、$(X_G^2+Y_G^2)$に対する（α_T/α_S）の特性グラフを記載した場合、$(X_G^2+Y_G^2)$の値が大きくなるほど（α_T/α_S）の値が大きくなるように補助舵角制御感度α_Sと駆動力配分制御感度α_Tを設定すれば本発明に含まれる。つまり、（α_T/α_S）のグラフが右上がり特性のグラフであることを満たしていれば各制御感度特性マップは上に凸でも下に凸でもクレームを満足する。

また、本実施例においては、輪荷重配分制御装置を含むシステムについて説明してきたが、輪荷重配分制御装置が搭載されてない車両にも適用できるのは勿論であり、少なくとも補助舵角制御装置と制駆動力制御装置とが同時に搭載された車両には適用できる。

また、補助舵角制御装置として、実施例では前後輪を共に舵角制御する例を示したが、後輪もしくは前輪のみを補助舵角制御する装置であっても良い。

また、制駆動力制御装置として、前後輪駆動力配分装置の例を示したが、左右駆動力配分制御装置や各輪の駆動力を直接制御するトラクションコントロール装置や各輪の制動力を制御するアンチロックブレーキングシステム等であっても良い。

（発明の効果）

以上説明してきたように、本発明にあっては、補助舵角制御装置と制駆動力制御装置とが同時に搭載された車両の総合制御装置において、補助舵角制御の制御効果が大きな車両状態領域と制駆動力制御の制御効果が大きな車両状態領域とを少なくとも前後加速度を含む同じパラメータにより区別し、制御効果の大小に応じて制御感度を変更する手段とした為、両制御装置の同時作動時に制御効果の大きい装置側で制御量が制限されるのを防止しながら、両制御装置によるトータル的な制御効果の最適化を図ることが出来るという効果が得られる。

4.図面の簡単な説明

第1図は本発明の補助舵角と制駆動力の総合制御装置を示すクレーム対応図、第2図は前後輪舵角制御装置（補助舵角制御装置の一例）と前後輪駆動力配分制御装置（制駆動力制御装置の一例）とアクティブサスペンション制御装置（輪荷重配分制御装置の一例）との同時搭載車両を示す全体システム図、第3図は前後輪舵角制御装置の具体例を示す図、第4図は前後輪駆動力配分制御装置の具体例を示す図、第5図はアクティブサスペンション制御装置の具体例を示す図、第6図は各制御で制御効果の大きな車両状態領域を示す領域概念図、第7図は第1実施例の総合制御コントローラでの制御感度設定処理作動の流れを示すフローチャート、第8図は$(X_G^2+Y_G^2)$の値に対する補助舵角制御感度と駆動力配分制御感度の特性マップ

図、第９図は制御感度比特性グラフ図、第１０図は第２実施例の総合制御コントローラでの制御感度設定処理作動の流れを示すフローチャートである。

a …補助舵角制御装置

b …制駆動力制御装置

c …前後加速度検出手段

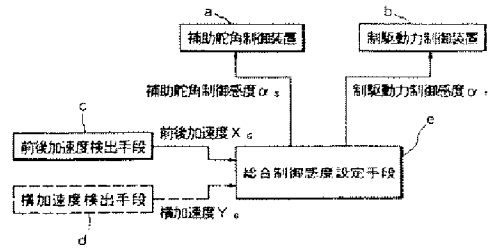
d …横加速度検出手段

e …総合制御感度設定手段

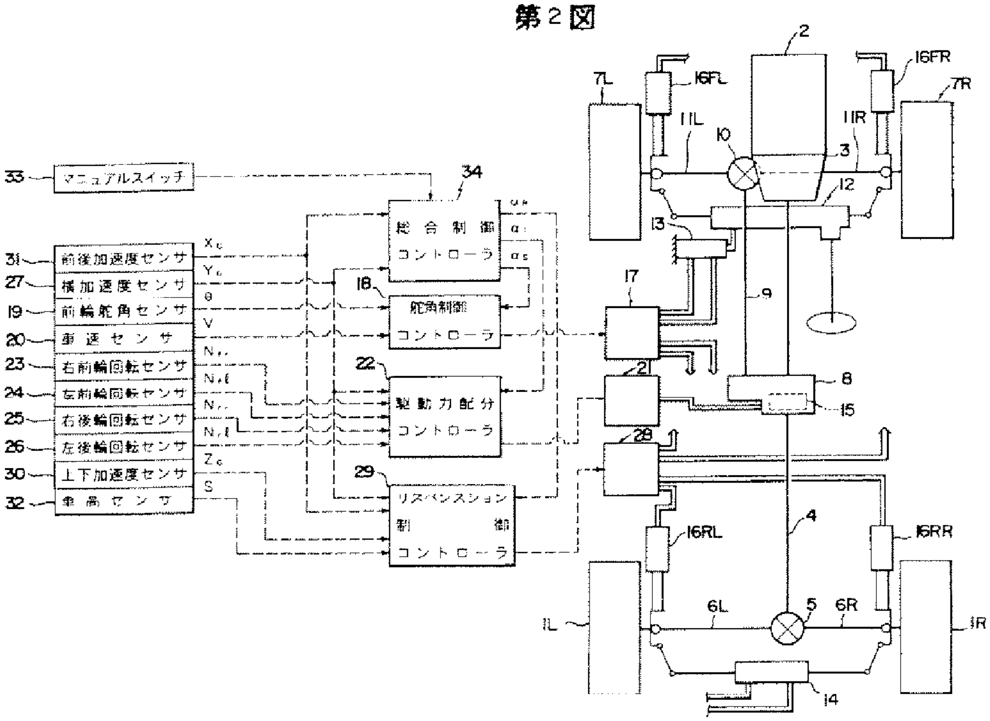
特許出願人

日産自動車株式会社

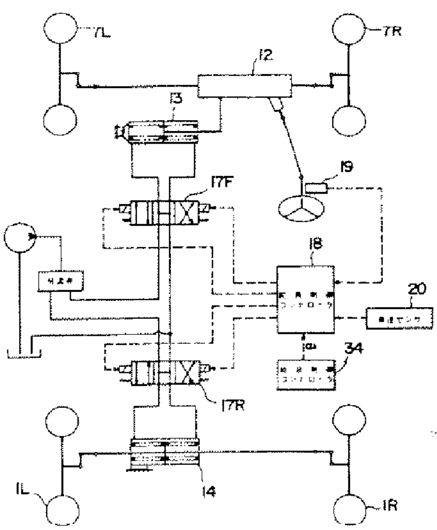
第１図



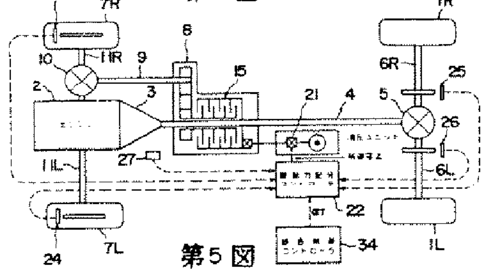
第２図



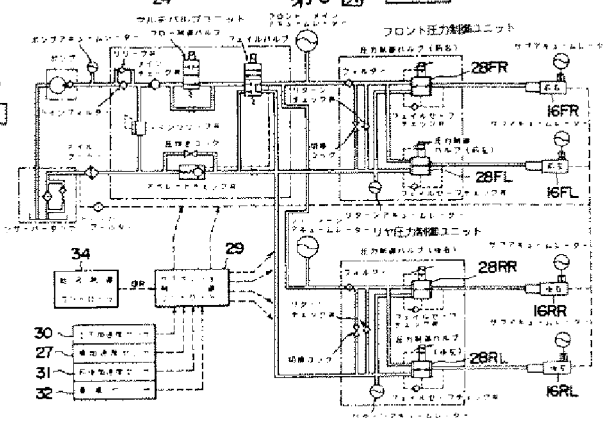
第3図



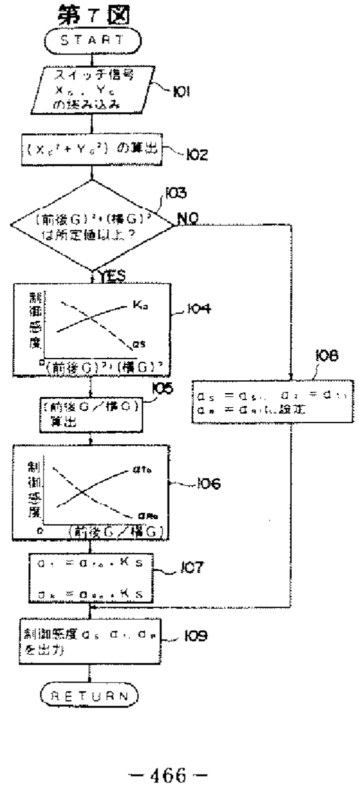
第4図



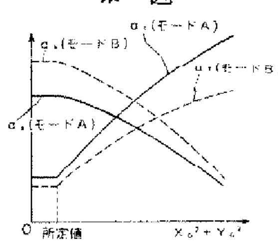
第5図



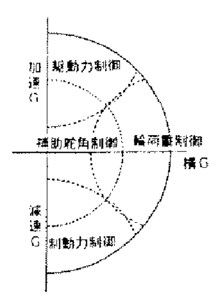
第7図



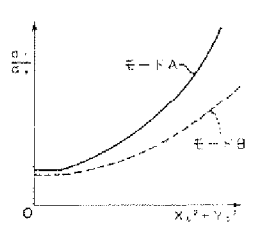
第8図



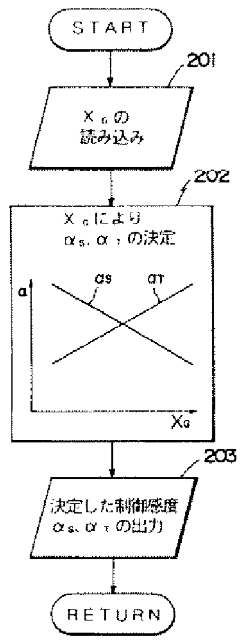
第6図



第9図



第10図


START
201
X_Gの
読み込み
202
X_Gにより
α_S, α_Tの決定
α_S
α_T
α
X_G
203
決定した制御感度
α_S, α_Tの出力
RETURN